

IMPORTANT

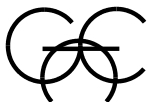
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GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION MATERIALS CONSULTANTS

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September 27, 2004

Edward E. Gillen Co.
218 West Becher Street
Milwaukee, Wisconsin 53207

Attention: Mr. Gary Jackson

Subject: Lake Michigan Bluff Stability Analysis
September 2004 Update
Bender Park
Oakwood Road
Oak Creek, Wisconsin
Project No. 1G-0309022

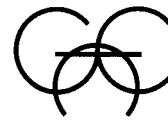
Dear Mr. Jackson:

The installation of additional wick drains and continued water level monitoring in the piezometers has been performed since the previous report dated August 19, 2004. One wick drain was installed in the southern study area, and one in the northern study area. Protective covers on two of the four water level monitoring piezometers were found to be missing and damaged from vandalism, sometime between the last two recording dates.

The contractors information on all of the wick drain installations is presented in the report prepared by the contractor, Underground Specialists, Inc., dated September 20, 2004. A discussion on the previously installed eight wick drains in the southern bluff study area, and three wick drains installed in the northern study area is presented in the previous Giles report dated August 19, 2004. A table of all recordings of the water levels in the monitoring piezometers is attached.

Summary of Wick Installations and Monitoring

The three initial wicks in the northern study area were installed from the bottom of the bluff. No water drainage from these wicks is visually apparent. These wick installations are considered unsuccessful since the water level monitoring indicated that little to no lowering of the water levels occurred in the bluff. Subsequently, one additional wick drain was installed from the top of the bluff in the northern study area, and completed during the week ending September 10, 2004. Water drainage from this wick is reported by the contractor. Water levels recorded in the north study area monitoring piezometers have decreased in elevation by 1± to 2± feet in comparison to the levels recorded prior to installation. Therefore, the installation of this wick drain is considered successful.



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The eight initial wick drains in the south study area were installed from the top of the bluff. The water level monitoring indicated that lowering of the water levels has occurred in the bluff. These wick installations are considered successful because the water levels measured are decreasing in elevation and water drainage from these wicks is visually apparent. Subsequently, one additional wick drain was installed from the bottom of the bluff in the southern study area, and completed during the week ending September 10, 2004. The installation from the bottom encountered problems similar to the wick installations from the bluff bottom in the northern study area. However, water drainage from this wick is reported by the contractor. This wick installation is therefore considered to be moderately successful. The water levels recorded in the southern study area piezometers have continued to decrease in elevation.

Conclusions

The study conducted to date indicates that wick drainage of subsurface water improves bluff stability. A successful lowering of the water levels with wick drains is occurring within the bluffs at the two study areas in Bender Park. The lower water levels are considered to increase the shear strength of the subsoils and therefore increase the stability of the bluff against deep-seated rotational failure. The study shows that wick drainage can be used to improve bluff stability without bluff crest, face, and bluff toe physical reconfiguration.

Wick installation with directional drilling techniques beginning at the top of the bluff is considered to be more successful at the Bender Park bluff conditions than installations from the bottom of the bluff. The Bender Park bluff conditions include accumulated soils at the bottom of the bluff from past slope failures, and clay soils containing sand and silt layers and/or lenses. A possible cause of the unsuccessful wick installation from the bottom of the bluff is borehole inward squeezing of soft soils. The insertion area contains an accumulation of disturbed (softer and less stable) soils from past slope failures. Another possible cause is that the drilling fluid inserted in the borehole at the bottom of the bluff is probably less effective in developing borehole stability with these bluff conditions, in comparison to fluid insertion from the top of the bluff. Less head pressure exists in the drilling fluid within the directionally drilled borehole when installed from the bottom to the top of the bluff. The greater pressure head from the drilling fluid installed from the top to the bottom allows for a more effective drilling fluid borehole stabilization.

The north study area water levels within the bluff are anticipated to decrease in elevation at a slower rate in comparison to the southern study area. The subsoils encountered at the test boring and piezometer locations in the northern study area include silt that is considered to have a slower permeability than the sand encountered by the subsurface exploration in the southern study area. The



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last recording on September 23, 2004 showing $1\pm$ and $2\pm$ foot lower water levels in the piezometers may be an indication of the anticipated slower lowering behavior, regardless that one wick drain logically will lower water levels slower than eight wick drains such as in the southern study area.

Recommendations

Continued recording of the water level monitoring piezometers is recommended. To study the wick drainage success during rising and elevated Lake Michigan water levels when more bluff instability regionally occurs, recording piezometer water levels at least twice a year for five additional years is recommended. More normal regional precipitation is possible during the next number of years and the water level of Lake Michigan possibly will rise as a result. Repair of the recent piezometer protective cover damage by vandalism is recommended to be done soon to provide protection of the piezometer function on a long term time frame.

Installation of additional wick drains in the northern study area at the top of the bluff is recommended. An increase in the rate of water level lowering is recommended to increase the bluff stability.

A buried hard piping system is recommended to collect the water from the wick drains. Hard piping, such as with PVC pipes fitted with rodent guards at their discharge ends will provide a more permanent discharge to daylight than the current bare wick, and will provide a demarcation for future repairs or additional wick installation if needed.

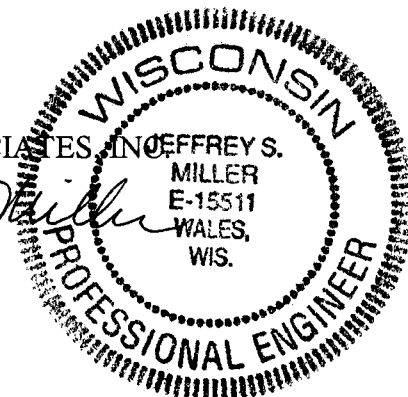
Closure

We appreciate the opportunity to have been of service on this project. If there are any questions or if we may be of further service, please call.

Very truly yours,

GILES ENGINEERING ASSOCIATES, INC. **JEFFREY S. MILLER**

Jeffrey Scott Miller
Jeffrey Scott Miller, P.E.
Sr. Project Manager



Enclosure: Table 1 Piezometer Record
Distribution: Edward E. Gillen Co.
Attention: Mr. Gary Jackson (3)

1g0309022-letter3/03Geo3/jsm

TABLE 1

Piezometer Record

Piezometer Location	Ground surface Elevation	Piezometer Elevation
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PZ 1	697	617
PZ 1A	698	638
PZ 2	696	621
PZ 2A	698	648
STS 1	695	
STS 2	695	

Pressure (psi) or Depth (feet)

10-2-03	11-21-03	12-24-03	5-18-04	5-24-04	7-8-04	8-4-04	8-18-04	9-23-04
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8.01	7.94	8.05	10.12	10.30	10.75	5.45	4.14	2.55
1.00	3.84	4.15	6.10	6.40	7.05	4.45	2.14	0.92
	14.96	14.79	16.80	17.10	17.30	17.60	17.45	16.94
	12.37	13.37	15.60	15.90	15.56	15.25	15.14	14.16
49.00		48.20	46.90	46.70	45.40			46.00
8.50		12.90	0.50	1.00	2.10			6.00

Piezometer Location

Water Level Elevation

10-2-03	11-21-03	12-24-03	5-18-04	5-24-04	7-8-04	8-4-04	8-18-04	9-23-04
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PZ 1	635	635	636	640	641	642	630	627	623
PZ 1A	640	647	648	652	653	654	648	643	640
PZ 2		656	655	660	660	661	662	661	660
PZ 2A		677	679	684	685	684	683	683	681
STS 1	646		647	648	648	650			649
STS 2	687		682	695	694	693			689

Notes:

5-24-04 after Spring heavy rainfalls

7-8-04 one week prior to wick installation

8-4-04 wick installation completed

9-10-4 additional wick installation completed